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A Distributed E2E Recovery mechanism for MPLS networks

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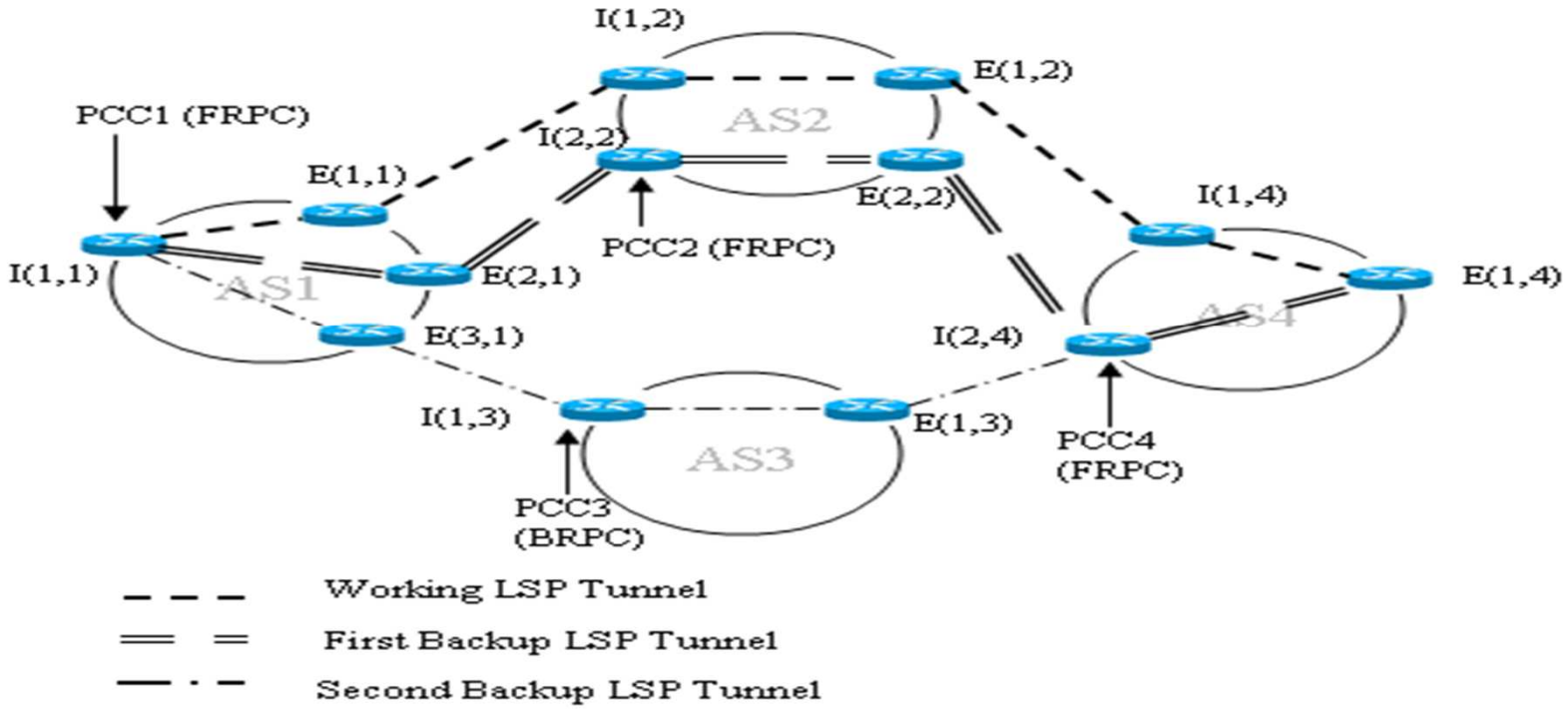
Overview



Objective:
Establishment of an E2E LSP backup tunnel.

Scope of application:
Per-domain or/and inter-domain node/link/SRLG failure.

Principle

•Two procedures of backup path establishment are applied:

- •**FRPC(Forward Recursive PCE Computation)**:
  ➔the backup path process reaches a domain to which the orignal working LSP tunnel belongs to.

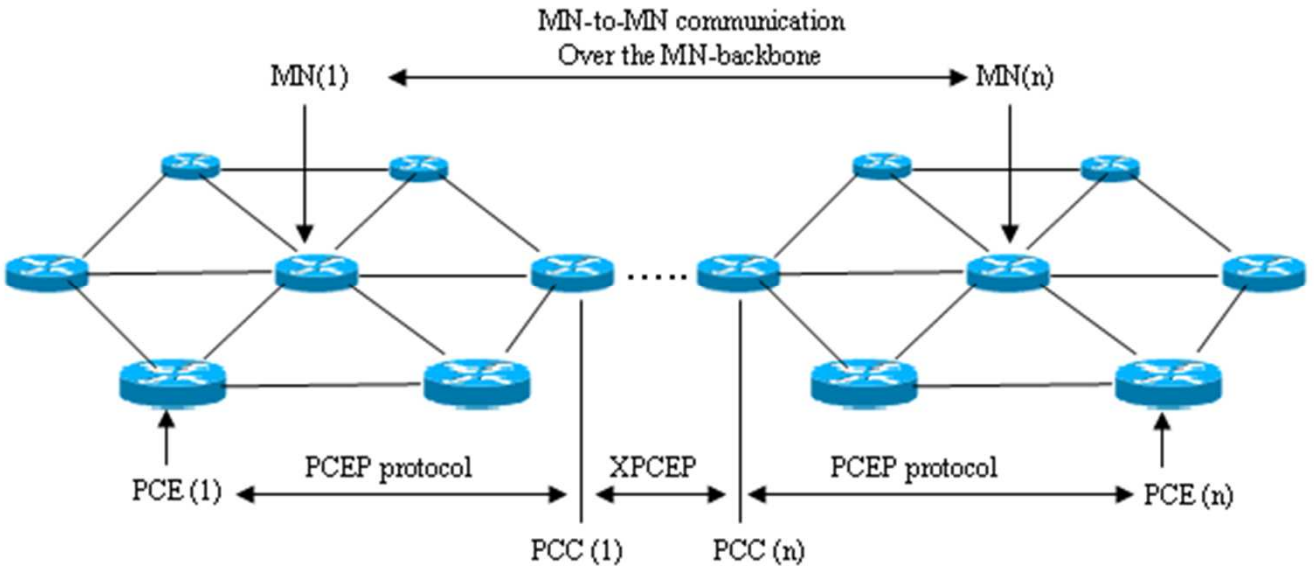
- •**BRPC (Backward Recursive PCE Computation)** :
  ➔the backup tunnel process reaches a domain to which the original working LSP tunnel does not belong to.

•BRPC is based on a tree named DBPT(Downstream Backup Path Tree)

- •A DBPT tree is MP2P (Mutli-point to point) TE LSP tree returned by a PCE to the upstream PCE
- •A DBPT tree defines, per-ingress-node, a set of relative paths that can be used to bypass a failure.
- •A DBPT is established at working LSP Tunnel setup.

•FRPC is based on locally defined databases : Internal and external LSP DataBases

Architecture



•PCE-to-PCE communication : exchange DBPT, requests/responses of establishing LSP backup tunnels.

- •Based on PCEP protocol.
- •extension of the PCEP protocol on inter-domain scope (by Kumaki and Murai , *PCEP extensions for a BGP/MPLS IP-VPN)*

•Discovery of neighbor PCE : extension of protocols IGP and BGP (RFC 5088 and RFC 5089)

Analytic evaluation

Let p be the probability of finding an Internal LSP that joins the original working tunnel
Let q be the probability of finding an External LSP that joins the original working tunnel.

The probability of finding a backup tunnel is:

Using FRPC

$$\begin{cases} \Pr_k = \alpha \sum_{i=0}^{n-(k+1)} \beta^i + \beta^{n-k} p \quad \forall k < n \\ \Pr_n = p \end{cases}$$

Using BRPC

$$\begin{cases} \Pr_k = \beta \Pr_{k+1} \\ \Pr_n = p \end{cases}$$

Where :

$$\alpha = p + q(1-p)$$
$$\beta = (1-p)(1-q)$$

$$Pr_k^{FRPC} - Prk^{BRPC} = \alpha \sum_{i=0}^{n-(k+1)} \beta^i \geq 0$$

- The probability of finding a backup tunnel is greater with FRPC then with BRPC
- FRPC ensures less E2E-recovery time than BRPC.
- BRPC ensures less local resource-wasting than FRPC.

- BRPC procedure is based on the break-before-make model

→ connection is found before making any resources reservation

Performances evaluation(1)

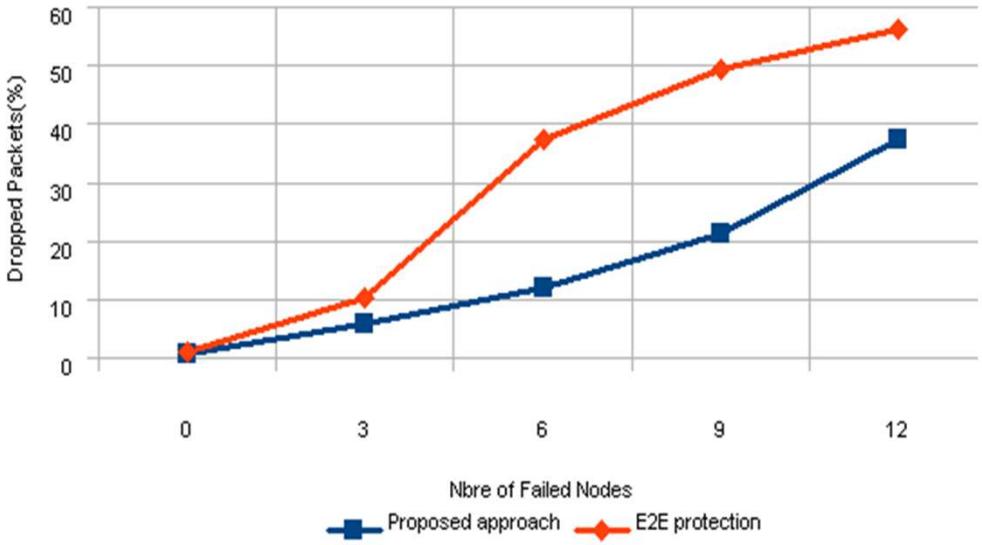
1) Recovery time, Pckt Loss and Pckt Disorder rates Comparaison

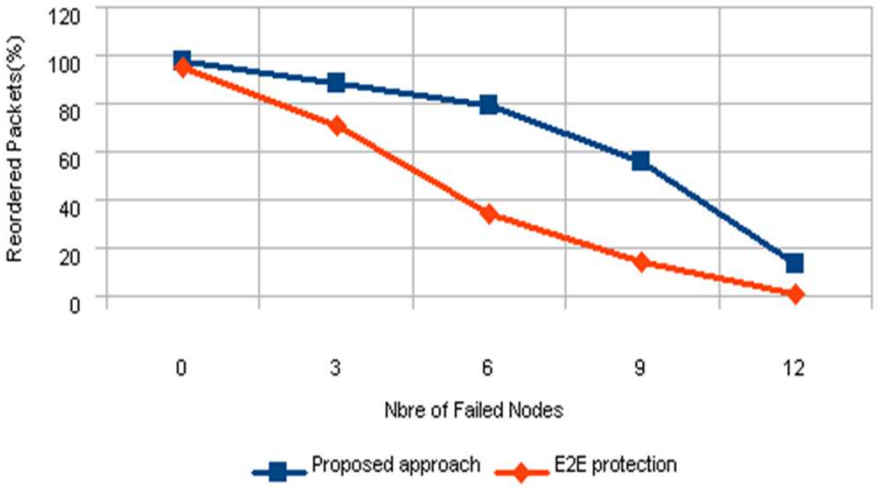
- IBLBT takes more time before rerouting activation
  - many updates should be applied on local LFIB within gateways and proxies.
- E2E recovery mechanism takes over 47 ms
  - This is due to notification and activation mechanism toward PSL and PML.
- The BGP recovery model remains although clearly divergent
  - recovery time ratio reaches over 53% (Proposed mechanism vs BGP)
- Similarly, the new mechanism ensures lower packet loss rate
  - it can reach a factor of 3,94 lower than the packet loss rate ensured by BGP.
- Packet disorder ensured by the BGP model can reach over a factor of 5.26 more than proposed mechanism.

	BGP recovery model	E2E Recovery Mechanism	IBLBT	Proposed mechanism
Time recovery	64 s	47,28 ms	31,34 ms	29,67 ms
Pckt Loss rate	47%	22%	13,5%	15,9%
Pckt Disorder	66,7%	36,18%	9,87%	7,67%

Figure: Comparison between various approaches for inter domain recovery

2) Pckt re-order and Pckt drop Evaluation





Conclusion

•The problem of End to End recovery in MPLS-based multi-domains networks.

• A mechanism for failure handling and traffic protection despite heterogeneity and autonomy of crossed areas.

• An alternative call between two path computation procedures

- •BRPC (Backward Recursive PCE Computation)
- •FRPC (Forward Recursive PCE Computation).

Main drawback : convergence of seraching process?

What is the probability to reach a domain to which the original working tunnel belongs to!!!

Thank You

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